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Description

The present invention concerns a hot melt, magnetized sealant according to the precharacterizing portion of claim 1. The invention further comprises a method of manufacturing that sealant and a method for sealing an irregular surface in using said sealant.

The present invention relates to the field of art which pertains to sealants and adhesives, in particular those which possess magnetic properties.

Synthetic adhesives having magnetic properties have been known for some time. The magnetic property of these adhesives is created by introducing magnetic particles of small particle sizes, typically below 150 microns, into the base adhesive composition. However, it is known that the introduction of increasing amounts of these magnetic particles, while increasing the magnetic properties of the adhesive, also significantly reduces the sealant's flow properties. This creates a problem when the adhesive is placed over an irregular surface wherein a portion of the adhesive is not in contact with the substrate. In such a situation, the magnetic attraction of the adhesive may be sufficient to maintain the sealant in place on the substrate, however it may not be sufficient to overcome the high viscosity of the resin and draw it into all of the irregularities on the substrate, thereby failing to create a void-free seal.

To overcome this high viscosity, one may try to increase the magnetic strength of the adhesive by introducing once of the magnetized particles thereby increasing the magnet strength of the tape. However, it has been found that by increasing the concentration of the magnetic particles disclosed in the prior art, the viscosity of the adhesive is increased, thereby making it more difficult to flow and offsetting the increase in magnetic strength. An alternative approach is to lower the concentration of magnetic particles in the adhesive thereby reducing their effect on the viscosity of the resin. However, this in turn reduces the magnetic attraction of the adhesive to the substrate such that the adhesive will not remain in position on the substrate during processing.

This problem is particularly acute in the automobile industry's attempt to seal ferrometallic components which are situated at near vertical positions in the automobile and which have irregular surfaces or where the adhesive must be overlapped when applied. It has been found that prior art adhesives having sufficient magnetic properties to maintain their position on the substrate during processing and curing do not possess sufficient flowability to seal the components without leaving voids in the seal, through which water or exhaust vapors may be forced into the passenger compartment. One particularly troublesome spot is the "toe plate" on the car which is the vertical plate behind the pedals and under the glove compartment on the passenger's side.

Therefore, what is required in this art area is an improved magnetic, hot melt adhesive which will have sufficient magnetism to maintain its position on a substrate which is near vertical during the curing process yet will have improved flowability resulting in a seal which is void free.

The GB-A-2 143 533 discloses a weldable sealant composition having a high viscosity and containing ferrous metal particles in an amount of 1-40% by weight and having a particle size of 44 to 150 micrometers.

The FR-A-2 418 266 discloses magnetized adhesives comprising magnetized particles having a mean particle size of about 1.8 micrometers.

The sealant of the present invention is defined by the features disclosed in the characterizing portion of claim 1. The method of manufacturing the sealant is defined by the steps of the characterizing portion of claim 7 and the sealant is defined by the steps of the characterizing portion of claim 8.

The present invention is for an improved hot melt, synthetic adhesive comprising a synthetic adhesive resin impregnated with 60 % to 80 % by weight of magnetic particles having a particle size greater than 150 micrometers. The adhesive has improved flowability at the higher concentrations of magnetic particles due to the removal of the lower end particle sizes below about 150 micrometers. It has been determined that by removing these smaller particle sizes, a higher concentration of particles may be introduced into the adhesive without substantially reducing its flowability during curing. This results in an adhesive which, when the adhesive is overlapped, or applied to an irregular surface, will result in a substantially void-free seal.

Additionally, the application is directed to a method of making an improved hot melt, synthetic, magnetic adhesive having the above disclosed composition.

Further, this invention discloses a method of sealing an irregular surface, using the improved adhesive disclosed, to form a seal which is substantially void free.

Other features and advantages will be apparent from the specification and claims and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a cross-sectional view of a typical lap joint of magnetic adhesive prior to curing.

Fig. 2 is a cross-sectional view of a typical lap joint of cured prior art adhesive.

Fig. 3 is a cross-sectional view of a typical lap joint of cured adhesive of the present invention.

Fig. 4 is comparative test results indicating percentage of acceptable seals in a lap joint test of identical resins between the prior art adhesive and the present invention.

Fig. 5 shows comparative test results indicating gauss strength of the prior art adhesive and the present invention.

Conventional synthetic sealants may be used to practice this invention. The basic resin adhesive may be thermoplastic or thermosetting. These hydrocarbon resins may be both aromatic or aliphatic with the aromatic resins being preferred. Typical thermoplastic materials are hydrocarbon resins, which are typically used in the adhesive and sealant industry such as styrene and acrylic monomers, while typical thermosetting resins may be ethylene propylene diene terpolymer (EPDM), polyisoprene, and styrene butadiene. The preferred material being styrene butadiene rubber resins. Some preferred styrene butadiene materials may be Ameripol 1009 available from B. F. Goodrich Company, and Kraton 1101 available from Shell Chemical Company. Other conventional resin systems such as Wingtac 95, Wingtac 10, Escorez 2001, Nevchem 100, Amoco 210 and Hercules A75 may also be used. The adhesive will typically be composed of 20 percent to 40 percent of the base synthetic resin material, with 25 percent to 33 percent by weight being preferred, exclusive of the magnetic particles, the rest of the adhesive will be composed of additives.

Conventional additives may be added to the base adhesive resin to gain the requisite physical properties of a particular sealant material. These will typically be, but need not be limited to, adhesive agents, fillers, or plasticizers which are typically used to prepare sealants or adhesives. Adhesive curing agents may be methacrylates, epoxies, polyamides, while typical fillers may be calcium carbonate, clay, barrites or silica and plasticizers such as adipates, phthlates, and process oils such as naphthenic or paraffinic. Such adhesive agents are normally present in concentrations from 0 percent to 7 percent by weight. The fillers are present from 0 percent to 25 percent by weight and the plasticizers are present from 5 percent to 30 percent by weight, each of these being in percent by weight of she adhesive prior to the introduction of the magnetic particles.

The key feature of the invention is the ability to increase the magnetic properties of the adhesive without substantially reducing the adhesives ability to flow during cure. This objective is accomplished by limiting the particle size of the magnetic particle to those which are greater than 150 µms and preferably between 150 µms to 650 µm. One simple way of selecting the particles in a particular range is to pass the particles through a series of standard screens or sieves and utilize that portion of the particles which remain on the 150 µm (100 mesh ASTM (American Society for Testing and Materials)) or higher screen while discarding that which passes through.

It is the omission of the lower particle sizes, from these sealants which allows for an introduction of increased weight percent of magnetic particles but without substantially decreasing the flowability of the adhesive during curing which is contrary to prior art teachings.

These larger particle sizes of the magnetic material are mixed with the adhesive resin in concentration of 60 percent to 80 percent by weight with 65 percent to 75 percent being preferred.

These particles may be comprised of any conventional magnetizable material such as barium ferrite or strontium ferrite, other materials may be iron oxides, i.e. Fe_3O_4, Fe_2O_3, or powdered Alnico alloys with the preferred being strontium ferrite.

The preparation of these adhesive materials requires mixing the adhesive resin and other components into a homogenous mixture. It may be that to ensure ease of mixing, the adhesive should be heated or warmed to a temperature which will allow for ease of mixing but will not cure the resin. Typically, this temperature will be 50 °C to 70 °C.

Once the adhesive has been mixed, the magnetizable particles are mixed in with the resin and typically are dispersed uniformly throughout the adhesive. All of this may be performed using conventional mixing or stirring devices.

The adhesive is then extruded through conventional extrusion equipment into a tape or other desired form. It should be noted that since the particle sizes used in the sealant may be larger than normally used in extrusion processess, the extrusion head should be selected to have an opening to accommodate them. Should one be using a selectively small extruder head opening, the particle size range of the metallic particles may be limited accordingly.

The extruded material is then passed through an electrical field which magnetizes the particles and aligns them in strips or lines along the tape. These electrical fields are conventional and may be generated by A.C. rectified current, direct current or capacitor discharge. The magnetized adhesives will typically have gauss readings of 150 to 300. These gauss readings will be an average over a number of positions along the tape and it is desired and preferred that the gauss readings be in excess of 200.

Once the tape has been magnetized, it may be cut into the desired lengths or shapes and is ready to apply it to a substrate.

Although this material may be applied to any ferrometallic surface to seal or bond it, it is particularly designed to be used when, for one reason or another the adhesive cannot be in total contact with the substrate and the substrate is in a near vertical position. Such situations require an adhesive which has excellent flow properties when heated but with sufficient magnetic strength to maintain its position during curing. As discussed in the introduction of the specification this often occurs when one piece of tape overlaps another as shown in Fig. 1. This figure shows a metal substrate 2 for an automobile wherein the adhesive strips 4 and 6 have been overlapped leaving a sizable gap 8 between the adhesive and the substrate. When the adhesive is cured through the application of heat, its viscosity is reduced and the magnetic particles draw the adhesive into the gap, thereby filling it as demonstrated in Fig. 3.

The prior art sealant, when overlapped and cured, would leave a void through which water or exhaust fumes could pass and enter the passenger compartment. This is depicted in Fig. 2 in which the substrate 2 on which two adhesive strips 4 and 6 are placed, one overlapping the other. When the sealant is cured, a void 10 (exaggerated to more clearly show the voids) remains due to the fact that sealant was not capable of free enough flow to fill the gap which existed when the sealant strips were overlapped or in the alternative, the adhesive strip would flow properly but the magnetic strength would have been reduced so low that the adhesive would slide off of its position on the substrate.

The magnetic sealant of the present invention has superior qualities over similar adhesives of the prior art in that it allows for the introduction of increased quantities of magnetic particles into the resin thereby increasing it's ability to adhere to the ferrometallic substrate, even when that substrate is at a difficult angle, yet will flow properly when heated and cured to produce a seal which is substantially void free even on irregular substrate surfaces.

Although there is no accepted way of measuring the flowability of these sealants, one test which is accepted in the automobile industry is to lap joint the adhesive, then cure it and then squirt water under the lap-jointed region and note any water which emerges. If water passes through, then the joint fails.

The ability of the present sealants to flow better and fill the voids in irregular surfaces is evident from the results of comparative tests performed using the resin system of the example above and varying the quantity of magnetic particles and their sizes. Two studies were made, one where the particle sizes used were below 150 µm and the other where the same resin system was used and introducing magnetic particles greater than 150 µm as taught in the present disclosure.

The magnetic tape was prepared having 60 percent, 70 percent and 76 percent by weight of each type of particles. The strips were 1.77 mm (0.07 inch) thick, 5.0 cm (2 inches) wide, and were laid up in lap joint arrangement on a sheet of steel and cured at 163°C for one-half hour. The resulting lap joints were then tested to see if any water could be forced through the joints. If water passed through the joint, then the joint was not sealed and it was considered unacceptable. The failure of the joint to properly seal is an indication of its inability to flow properly. As may be seen in Fig. 4, as the concentration of the smaller particles are increased, the flow is reduced and the number of acceptable seals (indicated by B) achieved is much lower than those achieved when the same quantity of particles which are in excess of 150 µm in size (indicated by A) are added to the resin.

Additionally, it is shown in Fig. 5 that the use of the coarser particles does not reduce the magnetic strength of the sealant when the same weight percent is used. This results in a sealant which will stay in place during curing, yet will flow sufficiently to seal an irregular surface.

Claims

1. A hot melt, magnetized sealant particularly adapted for use on ferrometallic material comprising a synthetic resin sealant containing magnetic particles characterized in that said magnetic particles are present in an amount of 60 % to 80 % by weight and the particle size is greater than 150 µm.

2. The sealant of claim 1 characterized in that the particle sizes of the magnetic particles is 150 µm to 650 µm.

3. The sealant of claim 1 characterized in that the magnetic particles are selected from the group consisting of barium ferrite, strontium ferrite and mixtures thereof.

4. The sealant of claim 1 characterized in that the resin is a styrene butadiene rubber.

5. The sealant of claim 1 characterized in that the synthetic adhesive is a thermoplastic material.

6. The sealant of claim 1 characterized in that the synthetic adhesive is a thermosetting material.

7. A method of manufacturing an improved hot melt, magnetized adhesive particularly adapted for use on ferrometallic material characterized in comprising homogeneously mixing a synthetic resin adhesive with 60 % to 80 % by weight of magnetizable particles having particle sizes greater than 150 µm; extruding said mixtures to form a thin tape of adhesive material, passing said tape through an electromagnetic field thereby magnetizing the particles, said adhesive having improved magnetic properties and flow characteristics.

8. A method for sealing an irregular surface using a hot melt, magnetized adhesive characterized in comprising applying a strip of a hot melt, magnetized adhesive of a synthetic resin containing 60 % to 80 % by weight of magnetized particles having particle sizes greater than 150 µm, heating the magnetic adhesive to cause the adhesive to become compliant and drawn onto the substrate by the magnetic field.

Revendications

1. Matériau d'étanchéité thermofusible magnétisé et conçu, en particulier, pour être utilisé sur des matières ferrométalliques, comprenant un matériau d'étanchéité en résine synthétique contenant des particules magnétiques, **caractérisé en ce que** lesdites particules magnétiques sont présentes en une quantité de 60% à 80% en poids et la granulométrie est supérieure à 150 µm.

2. Matériau d'étanchéité selon la revendication 1, **caractérisé en ce que** la granulométrie des particules magnétiques est de 150 µm à 650 µm.

3. Matériau d'étanchéité selon la revendication 1, **caractérisé en ce que** les particules magnétiques sont choisies parmi le groupe comprenant le ferrite de baryum, le ferrite de strontium et des mélanges de ces derniers.

4. Matériau d'étanchéité selon la revendication 1, **caractérisé en ce que** la résine est un caoutchouc de styrène-butadiène.

5. Matériau d'étanchéité selon la revendication 1, **caractérisé en ce que** l'adhésif synthétique est une matière thermoplastique.

6. Matériau d'étanchéité selon la revendication 1, **caractérisé on ce que** l'adhésif synthétique est une matière thermodurcissable.

7. Procédé de fabrication d'un adhésif amélioré thermofusible magnétisé et conçu, en particulier, pour être utilisé sur une matière ferrométallique, **caractérisé en ce qu'**il consiste à mélanger intimement un adhésif de résine synthétique avec de 60% à 80% en poids de particules magnétisables dont la granulométrie est supérieure à 150 µm; extruder ledit mélange pour obtenir un mince ruban de matière adhésive; faire passer ledit ruban à travers un champ électromagnétique, permettant ainsi de magnétiser les particules, ledit adhésif manifestant des propriétés magnétiques et des caractéristiques d'écoulement améliorées.

8. Procédé destiné à étancher une surface irrégulière en utilisant un adhésif thermofusible magnétisé, **caractérisé en ce qu'**il consiste à appliquer une bande d'un adhésif thermofusible magnétisé d'une résine synthétique contenant de 60% à 80% en poids de particules magnétisées dont la granulométrie est supérieure à 150 µm; chauffer l'adhésif magnétique pour qu'il épouse la forme du substrat et qu'il soit attiré sur le substrat à l'intervention du champ magnétique.

Patentansprüche

1. Magnetisierte Heißschmelzdichtmasse, insbesondere zur Verwendung auf ferrometallischem Material, mit einer Kunstharzdichtmasse, die magnetische Partikel enthält, dadurch gekennzeichnet, daß die magnetischen Partikel in einer Menge von 60 bis 80 Gew.% vorliegen und die Partikelgröße größer als 150 µm ist.

2. Dichtmasse nach Anspruch 1, dadurch gekennzeichnet, daß die Partikelgrößen der magnetischen Partikel von 150 µm bis 650 µm reichen.

3. Dichtmasse nach Anspruch 1, dadurch gekennzeichnet, daß die magnetischen Partikel aus der Gruppe ausgewählt sind, die aus Bariumferrit, Strontiumferrit und Gemischen derselben besteht.

4. Dichtmasse nach Anspruch 1, dadurch gekennzeichnet, daß das Harz ein Styrol/Butadien-Kautschuk ist.

5. Dichtmasse nach Anspruch 1, dadurch gekennzeichnet, daß der synthetische Klebstoff ein thermoplastisches Material ist.

6. Dichtmasse nach Anspruch 1, dadurch gekennzeichnet, daß der synthetische Klebstoff ein warmhärtendes Material ist.

7. Verfahren zum Herstellen eines verbesserten magnetisierten Heizschmelzklebstoffes, insbesondere zur Verwendung auf ferromagnetischem Material, gekennzeichnet durch homogenes Mischen eines Kunstharzklebstoffes mit 60 bis 80 Gew.% magnetisierbaren Partikeln, deren Partikelgrößen größer als 150 µm sind; Extrudieren der Gemische, um ein dünnes Band Klebstoffmaterial zu bilden, Hindurchleiten des Bandes durch ein elektromagnetisches Feld, um dadurch die Partikel zu magnetisieren, wobei der Klebstoff verbesserte magnetische Eigenschaften und Fließeigenschaften hat.

8. Verfahren zum Versiegeln einer unregelmäßigen Oberfläche unter Verwendung eines magnetisierten Heißschmelzklebstoffes, gekennzeichnet durch Aufbringen eines Streifens eines magnetisierten Heißschmelzklebstoffes aus einem Kunstharz, das 60 bis 80 Gew.% magnetisierte Partikel enthält, welche Partikelgrößen von mehr als 150 µm haben, Erhitzen des magnetischen Klebstoffes, um den Klebstoff nachgiebig zu machen und durch das magnetische Feld auf das Substrat zu ziehen.

FIG. 1

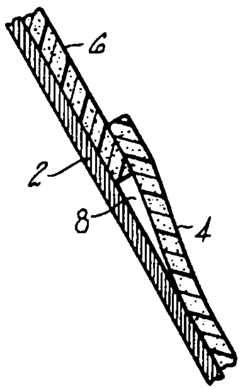


FIG. 2 PRIOR ART

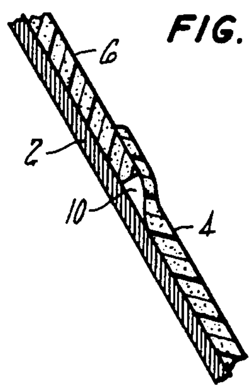


FIG. 3

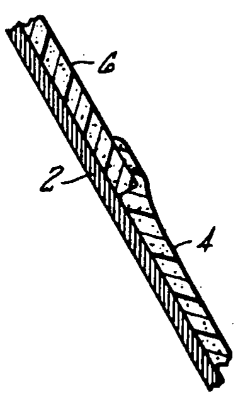


FIG. 4

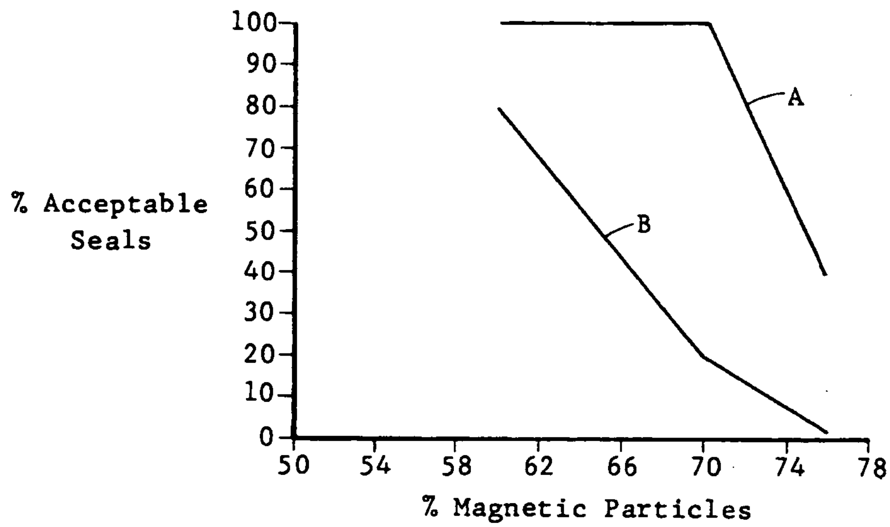
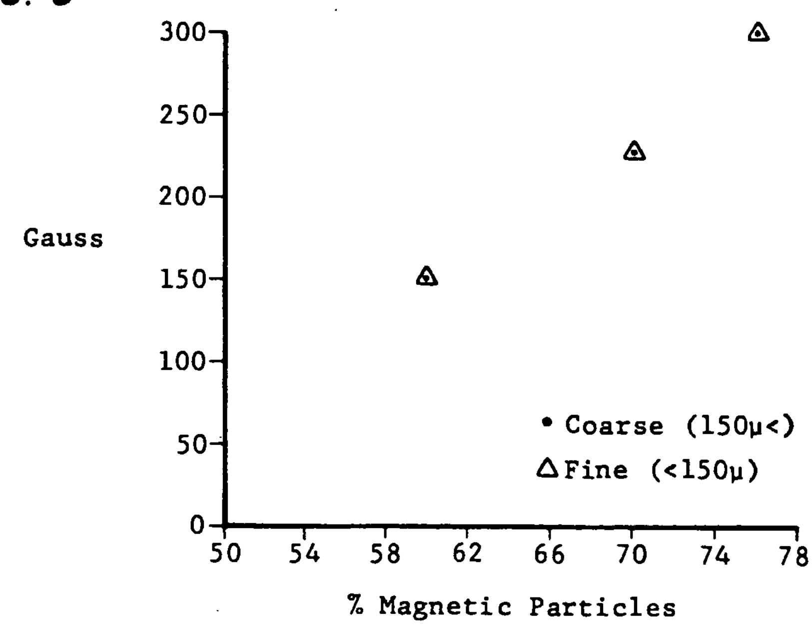

100
90
80
70
60
50
40
30
20
10
0
% Acceptable Seals
A
B
50
54
58
62
66
70
74
78
% Magnetic Particles

FIG. 5


300
250
200
150
100
50
0
Gauss
• Coarse (150μ<)
△ Fine (<150μ)
50
54
58
62
66
70
74
78
% Magnetic Particles